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An indentation study

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Publication date:
2014

Document Version
Early version, also known as pre-print

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Striepe, S., Deubener, J., Potuzak, M., & Smedskjær, M. M. (2014). *Influence of thermal history on micro-mechanical properties of earth-alkaline aluminosilicate glasses: An indentation study*. Abstract from 1st Joint Meeting of DGG – ACerS GOMD, Aachen, Germany.

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ABSTRACT

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Influence of thermal history on micro-mechanical properties of earth-alkaline aluminosilicate glasses: An indentation study

The properties of glass are not only determined by their chemical composition, but also by their thermal history due to the non-equilibrium nature of the glassy state. Hence, understanding the dependency between mechanical properties and thermal history of glass is of great scientific and technological importance. We have investigated the thermal history dependence of Young's modulus, Vickers hardness, and cracking behavior for an alkaline earth aluminosilicate glass composition over a wide range of fictive temperatures (≈ 130 K). Young's modulus, hardness, and brittleness index monotonically increase with decreasing fictive temperature, whereas the crack resistance decreases. On the other side we varied the environmental conditions e.g. the relative humidity to investigate the effects on fatigue in dependence of the fictive temperature. We found Vickers hardness to remain unaffected by the environmental changes, while stress intensity and crack resistance decrease significantly. Glasses with lower fictive temperature reveal larger changes in both parameters when the atmosphere changed from dry to wet. Further the sub-critical crack growth was found to be larger in the low fictive temperature glasses, indicating a diminished resistance against fatigue and stress corrosion.